

What is Claimed Is:

- 1 1. An microfluidic device comprising:
 - 2 A) a substrate with a top surface comprising a channel, wherein the
 - 3 channel has a width, a bottom and a sidewall; and
 - 4 B) a cover positioned over the substrate in alignment with the
 - 5 substrate,
 - 6 wherein the channel is accessed through an access port to the channel, the
 - 7 access port positioned on at least one of the cover and the bottom.
- 1 2. The microfluidic device of claim 1 wherein the access port to the
- 2 channel is an opening on the channel bottom.
- 1 3. The microfluidic device of claim 1 wherein the access port to the
- 2 channel is an opening on the cover.
- 1 4. The microfluidic device of claim 1 wherein the channel bottom is
- 2 coplanar with the top surface of the substrate, and the channel sidewall rises
- 3 from the substrate surface at an angle between about 45 and 135 degrees,
- 4 wherein the substrate, and the sidewall are composed of a polymeric
- 5 material.
- 1 5. The microfluidic device of claim 4 wherein the channel sidewall
- 2 comprises a thin region of the sidewall.
- 1 6. The microfluidic device of claim 5 wherein the sidewall
- 2 comprises a plurality of thinned regions.

1 7. The microfluidic device of claim 5 wherein a metal is deposited
2 on the thinned region.

1 8. The microfluidic device of claim 1 wherein the channel bottom
2 is beneath a plane co-planar with the top surface of the substrate.

1 9. The microfluidic device of claim 1 wherein the device further
2 comprising an alignment device adapted to align the cover with the substrate.

1 10. The microfluidic device of claim 9 wherein the alignment
2 device is a dowel pin positioned on the substrate.

1 11. The microfluidic device of claim 9 wherein the alignment
2 device is a protrusion positioned on the cover.

1 12. The microfluidic device of claim 9 wherein the alignment
2 device is accurate to better than 0.001 inch.

1 13. The microfluidic device of claim 1, the device further
2 comprising a capillary positioned in the channel access port and inserted in
3 the channel, wherein the access port has a diameter and the capillary has an
4 outer diameter, and wherein the capillary outer diameter and the access port
5 diameter are approximately equal.

1 14. The microfluidic device of claim 13 wherein an adhesive
2 secures the outer circumference of the capillary to the access port.

1 15. The microfluidic device of claim 13 wherein the capillary is
2 made of a second polymeric material that is transparent.

1 16. The microfluidic device of claim 1, the device further
2 comprising a capillary positioned in the channel access port and inserted in
3 the channel, wherein the capillary has an inner cross-sectional area and the
4 channel has a cross-sectional area and the capillary cross-sectional area and
5 the channel cross-sectional area are approximately equal.

1 17. The microfluidic device of claim 1 wherein the device
2 comprises a first and a second channel, the second channel positioned below
3 the first channel, the first channel has a conduit extending from the bottom of
4 the first channel to the second channel.

1 18. The microfluidic device of claim 1 wherein the device further
2 comprises a structure selected from the group consisting of a reservoir
3 structure, a detector window region, a microreactor and a distillation column,
4 wherein a capillary connects the channel to the structure.

1 19. The microfluidic device of claim 1 wherein the substrate
2 comprises a plurality of conical nozzles, the conical nozzles positioned in a
3 geometrical array.

1 20. The microfluidic device of claim 1 wherein the cover further
2 comprises an interconnecting duct, the duct connects to at least one channel
3 via the access port.

1 21. The microfluidic device of claim 1 wherein the sidewall
2 comprises an inner surface facing the channel and an outer surface opposite
3 the inner surface; and wherein the cover comprises a bottom surface, the

4 bottom surface facing the top surface of the substrate; the cover further
5 comprising a protrusion that extends from the bottom surface of the cover;
6 wherein the cover protrusion is adjacent to the inner surface of the sidewall.

1 22. The microfluidic device of claim 1 wherein the sidewall
2 comprises an inner surface facing the channel and an outer surface opposite
3 the inner surface; and wherein the cover comprises a bottom surface, the
4 bottom surface facing the top surface of the substrate; the cover further
5 comprising a protrusion that extends from the bottom surface of the cover;
6 wherein the cover protrusion is adjacent to the outer surface of the sidewall.

1 23. The microfluidic device of claim 22 wherein an interstitial
2 region is formed between the top surface of the substrate and the bottom
3 surface of the cover in regions bordering the outer surface of the sidewall.

4 24. The microfluidic device of claim 1 wherein the channel
5 comprises a channel structure positioned within the channel and oriented
6 perpendicular to the channel sidewall, and perpendicular to the channel
7 bottom.

1 25. The microfluidic device of claim 1 wherein the channel
2 comprises a first linear section and a second linear section, wherein the first
3 and second linear sections are perpendicular.

1 26. The microfluidic device of claim 1 wherein the channel bottom
2 has a width of greater than 100 μ m.

1 27. The microfluidic device of claim 1 wherein the channel
2 sidewall is between 10 μm and 50 μm in height.

1 28. The microfluidic device of claim 1 wherein the sidewall and
2 channel bottom are formed from the polymeric material.

1 29. The microfluidic device of claim 1 wherein the polymeric
2 material is a low melt viscosity polymer.

1 30. The microfluidic device of claim 29 wherein the polymeric
2 material is selected from the group consisting of polycyclic olefin polyalkane
3 co-polymers, poly methyl methacrylate, polycarbonate, polyalkanes,
4 polystyrenes and polymer blends containing a liquid crystalline polymer as an
5 additive.

1 31. The microfluidic device of claim 1 wherein the device
2 comprises an additional substrate, the additional substrate comprising a
3 channel architecture, wherein the substrates are bonded together, and further
4 wherein the device comprises a conduit connecting the channel and the
5 channel architecture.

1 32. A process of making a microfluidic device, the device
2 comprising a substrate and a channel architecture, the method comprising:

3 A. preparing an injection molding mold, wherein preparing the
4 injection molding mold comprises forming a negative impression of the
5 channel architecture;

6 B. injecting a polymeric material into the injection molding mold
7 or mold insert, and

8 C curing the polymeric material.

1 33. The process of claim 32 wherein the injection molding mold is
2 prepared from a material selected from the group consisting of metal, silicon,
3 ceramic, glass, quartz, sapphire and polymeric material.

1 34. The process of claim 32 wherein preparing the injection
2 molding mold comprises forming the negative impression of the channel
3 architecture by a technique selected from the group consisting of
4 photolithographic etching, stereolithographic etching, chemical etching,
5 reactive ion etching, laser machining, rapid prototyping, ink-jet printing and
6 electroformation;

1 35. The process of claim 32 wherein preparing the injection
2 molding mold comprises forming the negative impression of the channel
3 architecture by electroforming metal, and wherein the process further
4 comprises polishing said mold.

1 36. A microfluidic device comprising a substrate with a top surface
2 comprising a channel, wherein the channel comprises a bottom and a
3 sidewall, said substrate formed by a process comprising:

4 preparing an injection molding mold, wherein preparing the injection
5 molding mold comprises forming a negative impression of the channel;

6 injecting a polymeric material into the injection-molding mold;

7 curing the polymeric material to form the substrate; and
8 removing the substrate from the injection-molding mold.

1 37. A microfluidic device comprising:
2 A) a substrate with a top surface comprising a plurality of non-intersecting
3 channels, wherein each channel has a width, a bottom, and a sidewall; and
4 B) a cover positioned over the substrate in alignment with the substrate,
5 wherein each of the channels are accessed through an access port to the
6 channel, the access port positioned on at least one of the cover and the bottom.

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